Citation:

Geleijnse JM, Grobbee DE, Hofman A. Sodium and potassium intake and blood pressure change in childhood. *BMJ* 1990; 300: 899-902.

PubMed ID: 2337712

Study Design:

Prospective cohort

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

NEUTRAL: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To assess the association between sodium and potassium intake and the rise in blood pressure (BP) in childhood by comparing study children with high intakes of sodium and potassium with those children with low intakes.

Inclusion Criteria:

Between 1975 and 1978 the total population aged five years and older in two districts of Zoetermeer was invited to take part in a study of risk factors for cardiovascular disease (CVD).

Exclusion Criteria:

Children with established secondary hypertension were excluded.

Description of Study Protocol:

Recruitment

Between 1975 and 1978 the total population aged five years and older in two districts of Zoetermeer was invited to take part in a study of risk factors for CVD.

Design

Prospective cohort.

Dietary Intake/Dietary Assessment Methodology

Not applicable.

Blinding Used

Not applicable.

Intervention

Not applicable.

Statistical Analysis

- Six completed annual records of each subject were used in the analysis
- To quantify the change in blood pressure during the follow-up period, individual slopes of blood pressure against time were calculated by using linear regression analysis
- Association between sodium excretion, potassium excretion, urinary sodium to potassium ratio and BP slope was analyzed by multiple linear regression analysis
- Data are presented as mean changes per year and 95% CI
- Significance of differences was assessed by two-tailed tests throughout.

Data Collection Summary:

Timing of Measurements

- Children were examined four weeks after the initial examination and subsequently at yearly intervals
- Six complete annual records of each subject were used in the analysis.

Dependent Variables

- Blood pressure measurements were performed with a random zero sphygmomanometer
- Paramedical workers were trained to measure SBP and DBP according to a standardized protocol
- Cuffs 23cm by 10 or 14cm were used, depending on the arm circumference. In children, aged over 10 generally the largest cuff was used
- Blood pressure was measured in the left arm after 15 minutes sitting. Diastolic blood pressure was recorded at the 5th Korotkoff phase
- Two BP readings were taken and the average used for analysis.

Independent Variables

- Urine samples were analyzed for sodium and potassium concentrations by flame photometry
- Urine was collected as six timed overnight samples; collection began at supper and ended with the first urine voided the next morning
- Labelled containers were provided on which the subjects noted the times of starting and finishing each collection.

Control Variables

- Height and body weight were measured with the participant wearing light indoor clothing without shoes.

Description of Actual Data Sample:

- *Initial N:*
  - Of the 5,670 eligible subjects aged five to 19 years, 4649 (82%) were examined

- From this group a random sample of 596 children was selected for annual follow-up
- *Attrition (final N):* Of the 233 subjects in the cohort (authors selected children aged up to 17 at entry into the study and whose follow-up included at least six yearly examinations), 108 were boys and 125 girls.
- *Mean age:* 13 years
- *Ethnicity:* Not disclosed
- *Other relevant demographics:* Average body weight was 48.8kg
- *Anthropometrics:* Not applicable, not two groups
- *Location:* Zoetermeer, a suburban town in the western part of the Netherlands.

Summary of Results:

Average Sodium Excretion, Potassium Excretion, and Sodium to Potassium Ratio and Ranges According to Thirds of Distributions of Electrolyte Excretion in Study Groups During Following Period

	Mean	Range (Lower Third)	Range (Upper Third)
Sodium Excretion (mmol per 24 hours) Total Study Group	135.6	61.5-117.7	147.5-251.5
Potassium Excretion (mmol per 24 hours) Total Study Group	43.7	15.8-37.7	47.8-77.3
Sodium to Potassium Ratio (mmol per 24 hours) Total Study Group	3.3	1.1-2.8	3.6-7.4

Other Key Findings

- Boys mean 24-hour sodium excretion ranged between 61.5-251.5mmol, which reflects a daily salt intake of 3.6-147; in girls the mean 24-hour sodium excretion ranged between 68.5 and 215.3mmol, corresponding to a salt intake of 4.0-12.6g per day
- Urinary potassium excretion was strongly and inversely associated with SBP in this cohort (P=0.0004) whereas the SBP slope was higher when the sodium to potassium ratio was higher
- Mean yearly change in SBP was 1.4mmHg in the group with a high potassium intake and 2.4mmHg in the group with a low potassium intake.In children with a high sodium to potassium ratio a slope of 2.2mmHg per year was recorded compared with 1.4mmHg per year in children with a lower sodium to potassium ratio (P=0.02)
- Neither sodium nor potassium nor the sodium to potassium ratio was significantly related to the change of DBP.

Author Conclusion:

Dietary potassium and the dietary sodium to potassium ratio are related to the rise in blood pressure in childhood and may be important in the early pathogenesis of primary hypertension.

Reviewer Comments:

- *Authors did not discuss limitations of their research*
- *No nutrition assessment tool was used*
- *Question if the results are generalizable*
- *No funding sources were disclosed.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	???
3.	**Were study groups comparable?**	???

3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	N/A
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	???
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	???
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	???
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	No
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	???
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	No
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	???
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	???
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A

6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	N/A
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	Yes
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	???
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	Yes
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	???
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	No
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	???
7.5.	Was the measurement of effect at an appropriate level of precision?	???
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes

8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	???
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	No
8.7.	If negative findings, was a power calculation reported to address type 2 error?	No
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	???
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	No
10.	**Is bias due to study's funding or sponsorship unlikely?**	???
10.1.	Were sources of funding and investigators' affiliations described?	No
10.2.	Was the study free from apparent conflict of interest?	???